

Effect of Cold on Moulting.— In the American Naturalist for 1908 Mr. C. W. Beebe reported some experiments on male Scarlet Tanagers and Bobolinks to determine the effect of external factors on moulting and its sequence. His birds, confined in the dark, and rather over fed, held their nuptial plumage all summer and winter, and when brought into normal conditions the following spring, moulted from nuptial to nuptial, thus reversing the proper order.

In 1911 I made an experiment on a male Mallard Duck to determine primarily the effect of cold upon the moulting. I chose a Mallard of the toy variety because of its small size. At the same time I took as a control another male toy duck and placed them both in crates of similar sizes, about two and one half by one and one half feet.

The experiment was begun on April 15, 1911, when of course all Mallards are still in full dress. I was enabled to keep the bird to be experimented upon together with another animal experiment in a special room of the Quincy Cold Storage Plant in Boston, thanks to the kindness of Mr. G. V. Crocker. The room was kept at an even temperature of 25° F. Rarely it got as warm as 30° or as cold as 22°. It was practically dark, though lighted at times by electricity.

Both the cold room duck and the control duck were fed on the same ration of hard grain. Notes were made of both birds from time to time, and the cold room bird was visited about every ten days.

The observations in detail are added, but to sum up, the cold room bird kept his winter plumage all summer without shedding a feather and was taken out about November first and placed with the other ducks at Wenham. He remained the same all winter and moulted very early in the spring, rapidly assuming eclipse plumage.

The control duck, likewise closely confined, but out of doors assumed an eclipse plumage, although not a perfect one, and when liberated at the same time as the other bird, took on a delayed and rather imperfect winter dress. Both birds were very fat, but otherwise in perfect health throughout the whole period.

It is perhaps to be regretted that the control bird was not kept through the summer in the dark, as this would have tended to rule out the light factor. This factor may or may not have had a positive effect.

It is certain that close confinement alone greatly delayed and rendered less perfect the spring to summer and summer to winter moulting in the control bird, but it had no such effect as the cold and dark plus the confinement. The sequence of plumage was certainly governed by the season, as no attempt was made on the part of the cold room bird to change his left over winter dress when he was liberated in November.

The following notes were made at the time.

April 15, 1911. Experiment started.

June 24: The cold room bird showed no moulting, breast worn from the bars of the crate, and a small area of skin around both eyes denuded of feathers. Other mallards at Wenham were beginning to moulting at this date.

July 2: Control duck shows delayed moult, which is not to be wondered at on account of lack of exercise. So far only head and breast feathers affected.

July 27: No change in cold room bird.

August 8: The control duck shows black under tail coverts nearly gone, green on occiput and hind neck only, with a patch of it on the throat. White neck ring reduced, and absent dorsally. Breast nearly all moulted except for few old feathers at lower margin of the chestnut area. Flanks are moulting. The common mallards show at this date a much later and more complete eclipse plumage.

August 13: Cold room bird, no change except increased wear of feathers. Belly and under tail coverts badly worn. Sex feathers intact. Feathers coming back around eyes.

August 22: Cold room bird no change. Control bird, eclipse dress progressing slowly. The belly, however, is not yet moulted and there are still traces of neck ring laterally. Some of the mallard stock in perfect eclipse at this date; others slightly lacking. A good deal of variation among them. None show any white neck ring now, but several have greenish heads.

September 14: Cold room bird no change.

September 21: Control bird shows a beginning of the return of winter plumage, but eclipse has not been perfect.

Oct. 28: Cold room duck same as a month ago. (He was removed a few days after this, and remained without change all winter. The control was also liberated, but did not quite get back into full plumage and remained below par all winter.)

March 5, 1912: Control bird was noted as in ragged plumage with slight admixture of eclipse feathers on breast and on head. Cold room bird same — full winter dress but worn.

June 12: Control bird has started in to moult early, far earlier than any other mallard or toy mallard on the place. Breast spotted, belly partly moulted, sex feathers still intact, head brownish. The cold room duck is not so far advanced as the control, but more so than the other toys and mallards. Some mallards have not shed a feather yet. The center of the chestnut area of the cold room duck is changing and spotted, but not upper and lower margins, which are still pure chestnut, with young feathers underneath old feathers. Sex feathers intact.

From this time on eclipse plumage was rapidly assumed by both birds, and a stage maintained somewhat ahead of the other ducks on the place.—
J. C. PHILLIPS, *Wenham, Mass.*